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DEMONSTRATION OF EMERGING AREA SOURCE PREVENTION OPTIONS FOR VOLATILE ORGANICS

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DEMONSTRATION OF EMERGING AREA SOURCE PREVENTION OPTIONS FOR VOLATILE ORGANICS

ABSTRACT

The national ambient air quality standard for ozone (0.12 ppm) is exceeded in over 100 areas throughout the U.S. Extensive reduction of volatile organic compound (VOC) emissions is required for attainment. The difficulty of dealing with stationary area sources has been a major obstacle to attaining these reductions. Area sources may contribute as much as 50 percent of national VOC emissions, and the increasing emissions from such sources may be outpacing efforts to control the diminishing base of uncontrolled point source emissions.

A work group, under the leadership of EPA's Air and Energy Engineering Research Laboratory, is participating in a research program, entitled, "Demonstration of Emerging Area Source Prevention Options for Volatile Organics." The purpose of this presentation is to describe the program and its status.

The program's goal is to reduce VOC emissions from stationary area sources by developing, evaluating, and/or demonstrating pollution prevention options. The program includes two project areas: (1) Alternative Coating Materials and Processes, and (2) Consumer Product Prevention Options. Other work group members include EPA's Region 9, EPA's Office of Pesticides and Toxic Substances, EPA's Office of Air Quality Planning and Standards, the South Coast Air Quality Management District, the Northeast States for Coordinated Air Use Management, the New York State Department of Environmental Conservation, and the California Air Resources Board.

GLOSSARY OF ACRONYMS

AEERL	EPA, Air and Energy Engineering Research Laboratory
CARB	California Air Resources Board
EPA	U.S. Environmental Protection Agency
NAPAP	National Acid Precipitation Assessment Program
NASA	National Aeronautics and Space Administration
NESCAUM	Northeast States for Coordinated Air Use Management
NYSDEC	New York State Department of Environmental Conservation
OAQPS	EPA, Office of Air Quality Planning and Standards
OPP	EPA, Office of Pesticides Programs
OTS	EPA, Office of Toxic Substances
SCAQMD	South Coast Air Quality Management District
VOC	Volatile Organic Compound

BACKGROUND

The U.S. ozone non-attainment and air toxic problems have been among the most unyielding problems facing the U. S. EPA. Efforts to achieve extensive reductions in VOC emissions, thereby reducing ambient ozone concentration, have not been successful partly because of the difficulty of dealing with stationary area sources. An area source, as defined for this paper, is one that emits less than 9.1 Mg/yr (10 T/yr) of each VOC and less than 22.7 Mg/yr (25 T/yr) of combined VOCs. Collectively, small area sources may contribute as much as 50 percent of VOC emissions.

Since many of these sources are not amenable to add-on control devices, they must be mitigated through prevention methods such as product substitution, solvent reformulation, and evaporation control. Although some progress has been made, the lack of demonstrated substitutes for VOCs is commonly the principal barrier to reducing emissions from area sources. Many State and local agencies are trying to force reduction through regulation, but they are not able to push regulation beyond demonstrated technology. Industry seldom finds it advantageous to publicize progress and have it become the state-of-the-art for new regulations.

The goal of this project is to aggressively attack this standoff by understanding how to reduce VOC emissions from stationary area sources by developing, evaluating, and/or demonstrating pollution prevention options. The project consists of two tasks:

1) Demonstrating the viability of VOC emissions reduction through alternative coating materials and processes; and

2) Identifying and evaluating consumer product prevention options.

For each task, the concept to be employed is that VOC emissions will be reduced via prevention technology, inferring a decrease of ambient ozone concentrations and resulting in a reduction of exposure to air toxics. By the year 2000, the reduction for the source categories selected for this project could represent up to 9 percent of non-mobile area source VOC emissions. Industrial partners will be sought for each of the planned demonstrations and will be particularly important for the "demonstration of alternative coating materials" task.

DEMONSTRATING THE VIABILITY OF VOC EMISSIONS REDUCTION THROUGH ALTERNATIVE COATING MATERIALS AND PROCESSES

Several projects concerning alternative coatings will be conducted under this task. Many will be co-funded by EPA's Air and Energy Engineering Research Laboratory (AEERL), the South Coast Air Quality Management District (SCAQMD) (which includes Los Angeles), and industrial partners. Industrial partners will be identified during 1990. A work group including AEERL, EPA's Office of Air Quality Planning and Standards (OAQPS), EPA Region 9, the California Air Resources Board (CARB), and SCAQMD has been formed to provide guidance for this task. In addition, the work group will obtain feedback from representatives of EPA Regions 1 and 2, EPA's Office of Toxic Substances (OTS), the New York State Department of Environmental Conservation (NYSDEC), and the Northeast States for Coordinated Air Use Management (NESCAUM).

The focus of this effort will be the reduction of VOC and other emissions from coating operations. Coating operations release approximately 15 percent of stationary area source VOC emissions as estimated by the 1985 National Acid Precipitation Assessment Program (NAPAP) emissions inventory. Many of these sources cannot be impacted by add-on controls at a reasonable cost due to their small size and/or the difficulty of capturing emissions. The reduction of solvent emissions from architectural and other coatings

continues to rely on prevention technologies such as the replacement of VOC with water or non-photochemically reactive solvents; the use of high solids coatings; improvement of the efficiency of transfer of the coating to the coated surface; or improved capture and recycle of evaporating solvents. In current practice, reformulation with non-photochemically reactive solvents often leads to other environmental problems, such as increased toxicity, greater stratospheric ozone depletion potential, and worsened multimedia effects. These potential impacts will be evaluated and avoided throughout the coatings substitutes research effort. There is also potential for eliminating the use of solvent-based coatings altogether. The use of such coating-free materials would eliminate emissions during the manufacture and the life of the products by avoiding the coating process.

Three projects are proposed to prevent solvent emissions from coating operations. The first two, an Evaluation of Potential Coating Technologies and a Surface-Coating-Free Materials Workshop, will bring together information about opportunities for prevention, will provide a basis for future demonstration projects, and will allow the transfer of existing prevention technology from existing users and suppliers to other potential applications. The third project will consist of several Coatings Demonstration Projects.

1. EVALUATION OF POTENTIAL COATING TECHNOLOGIES

The potential of alternative solvents or coating formulations, improved application technology, and enhanced curing techniques for reducing the emissions of VOCs, air toxics, and other pollutants will be assessed. Several emerging technologies will first be screened to assess their potential for small- and large-scale demonstration.

Each promising technology's ease of use, process economics, suitable product appearance, and resulting product durability will then be demonstrated

in laboratory-scale testing. These evaluation and demonstration activities will consider the impact of military specifications and other widely accepted standards on the usefulness of the prevention technology. The focus of this effort will be on technologies which can prevent emissions from small, dispersed, stationary area sources. These include small job shops (such as auto refinishers and custom cabinet makers) and non-manufacturing settings such as architectural and industrial maintenance. However, technologies for larger area sources will be considered for demonstration if suitable opportunities for small, dispersed area source prevention are not available.

In addition, a report will be produced which will summarize the technical status of pollution prevention and control during the use of coatings. This will include the results of the preliminary evaluation studies. Of particular interest will be the evaluation of potential manufacturers' ease of use, manufacturing economics, product appearance, and product durability leading to an analysis of market potential.

2. SURFACE-COATING-FREE MATERIALS WORKSHOP

During the evaluation of potential coating technologies, the purpose is to identify coatings which are more environmentally acceptable than those currently in use. In contrast, the objective of the Surface-Coating-Free Materials Workshop is to eliminate the need for coatings entirely.

EPA's background work on VOC area sources has revealed that architectural and industrial maintenance coatings constitute a significant source of VOCs (an estimated 8 percent of 1985 non-mobile area source NAPAP emissions) and organic and inorganic wastes. Not only do emissions occur during the application of the initial coating, they occur each time the surface is recoated during the lifetime of the object or structure. If materials and/or products could be developed which do not need coating, during either

manufacture or use, significant reductions of VOC emissions, solid wastes, and sludges can be avoided. This effort will identify opportunities for the development of surface-coating-free materials. These results will be summarized in a report for use by industry and government researchers, and the general public interested in pollution prevention for coated materials.

The technical status of coating-free materials will be evaluated to identify opportunities for demonstration and of viability of these materials. Contacts will be established with industry (e.g., vinyl siding and metal products manufacturers) in order to identify key personnel, new developments, and opportunities. A dialogue will also be established with the Department of Defense and with the National Aeronautics and Space Administration (NASA) to identify emerging technologies. A workshop will then be sponsored in which opportunities will be identified and evaluated, and a technical basis for selection of several material or product technologies for further development will be established.

3. COATINGS DEMONSTRATION PROJECTS

Several demonstration projects will be undertaken to establish the economics, ease of manufacture, quality, and durability of products coated in a more environmentally acceptable manner. The first two will be demonstrations of a new coating system or systems for use by wood furniture manufacturers and by auto refinishers. These will begin during fiscal year 1991. It is anticipated that promising technologies will have already undergone preliminary evaluation and are available for demonstration in these areas. A third demonstration project will be identified during 1991 as the result of discussions with potential industrial partners, the Department of Defense, and/or NASA.

Additional demonstrations will be selected for completion during fiscal

year 1992 as a result of the Evaluation of Potential Coating Technologies effort and the Surface-Coating-Free Materials Workshop report. Each demonstration will result in a final report which will analyze other potential applications of the technology, schedule follow-up efforts to confirm the durability of resulting coated products, and evaluate its impact on VOC emissions.

CONSUMER PRODUCT PREVENTION OPTIONS

Two areas of research are included under this task. The first addresses consumer products and will support several efforts to reduce VOCs, air toxics, and other environmentally adverse emissions from these products. These efforts include Federal, State, and local regulatory development, the development of low-polluting product options, and the transfer of information to the public, industry, and interested government groups. The second effort concerns the use of VOCs, stratospheric ozone depleters, and greenhouse gases as pesticide inerts. The primary purpose of this effort is to reduce the amount of these compounds used in, and thereby emitted from, pesticides.

A work group including AEERL, OAQPS, EPA Region 9, EPA's Office of Pesticides Programs (OPP), EPA's OTS, NYSDEC, and NESCAUM has been formed to provide guidance for this task. In addition, the work group will obtain feedback from representatives of EPA Regions 1 and 2, CARB, and SCAQMD.

1. BACKGROUND AND ANALYSIS OF PREVENTION OPTIONS FOR CONSUMER PRODUCTS

A. Introduction

Consumer products are a significant, uncontrolled source of VOC emissions. Emissions from these products also contribute to air toxics, stratospheric ozone depletion, global climate problems, degradation of indoor

air quality, and multimedia effects. Add-on control devices are generally not economical for small, widely distributed sources such as consumer products. Hence, innovative pollution prevention options are needed. This program includes the resources needed to accelerate the process of developing and implementing these options. This will result in reduced ambient ozone and organic air toxic concentrations due to the release of fewer VOC emissions.

During 1989, AEERL and OAQPS, in a cooperative effort, initiated information gathering from the consumer products industry. The concept of consumer products was defined and the key players and product types were identified as a first step toward holding a symposium concerning these products. The Symposium on Regulatory Approaches for Reducing VOC Emissions From the Use of Consumer Products[1] or Consumer Products Symposium, was held with extensive industry participation during November 1989. On a parallel course, New York, California, New Jersey, and other states are continuing to develop regulations for consumer products. AEERL is working to expand New York's emissions estimate for the New York City metropolitan area to the entire NESCAUM region. In addition, AEERL has nearly completed studies of VOC emissions from aerosol products and charcoal lighter fluid.

OAQPS continues to be active in the consumer products area during 1990 by initiating projects which address issues which were identified as being critical at the Consumer Products Symposium. These projects include: 1) An inventory of VOCs in consumer products; 2) Determination of the fate of VOCs in consumer products in wastewater, 3) The fate of VOCs from consumer products after land disposal; 4) Aerosol consumer products study; 5) Analysis of potential VOC reductions from aerosol spray paints; and 6) Comprehensive background development for deodorants and antiperspirants.

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[1]U.S. Environmental Protection Agency. "Symposium on Regulatory Approaches for Reducing VOC Emissions from the Use of Consumer Products," EPA-450/3-90-008, January 1990.

B. Planned Research Activities

The program proposed in this research plan integrates pollution prevention concepts, the critical research needed for minimizing VOC emissions, AEERL's 1989 research results, state regulatory research and activities, and the anticipated results of OAQPS' 1990 program.

i. Consumer Product Test Method Development

The development of test methods for determining VOC emissions from consumer products has been identified as the highest priority research activity for this area source category. Many states are considering rules to limit VOC emissions or content of these products. These rules will use criteria such as maximum VOC content by weight or percentage of VOC removed from products via reformulation. There are presently no widely accepted methods for completing these measurements. Hence, the development of test methods is a key component of regulatory strategies to reduce VOC emissions from consumer products. Similarly, industry needs widely accepted methods to evaluate their progress in reducing VOC in their products.

Test methods are needed for several consumer product types, such as volatile organic liquids, aerosols, volatile organic solids, and solids containing residual organics. AEERL has initiated a work assignment to: 1) identify existing and potential test methods; 2) clarify the types of measurements needed to support the regulatory, inventory, and research communities; and 3) synthesize this information into a research plan. Examples of existing test method information include the OTS shelf survey of potential public exposure to chlorinated solvents and the methods identified in CARB's draft rule for consumer products.

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Test method development will begin during fiscal year 1991. Annual progress reports will be produced that describe the resulting methods in detail. Testing of specific products is not anticipated at this time.

ii. Prevention Options Research

Methods to reduce emissions from consumer products, which make up approximately 10 percent of the non-mobile area source VOC emissions inventory, are limited to prevention options, such as reformulation and product substitution. Although industry is ultimately responsible for developing new products which result in reduced emissions, this process must be accelerated to ensure that Clean Air Act Amendment deadlines are attained. In this process, there will likely be technical and institutional barriers to overcome. The Agency could play a key role in identifying and overcoming these barriers in order to facilitate change.

Prevention options research will build on the earlier efforts of the work group participants and other interested parties. Aerosols have been identified as a key area where significant impacts may be made through reformulation and product substitution. However, a significant scoping study is needed to identify other areas in which research and demonstrations are warranted. The proposed scoping study and demonstration project are described below.

a. Prevention Options Availability Report and Data Base

The objective of the first (scoping) study is to define the range and categories of products for evaluation during this effort. Emphasis will be on products that are the greatest contributors to VOC emissions based on existing emissions estimates. Within the defined scope of products, a priority list of solvent substitutes will be established for study. The focus will be on

identification of environmentally acceptable (i.e., with respect to VOC content, tropospheric ozone formation potential, and stratospheric ozone depletion potential) replacements for high volume photochemically reactive organic compounds used in the formulation of these products. Attention will be given to health-based concerns and multimedia effects. These key solvent substitutes will then be the focus of additional studies directed toward assessment of safety considerations, such as acute and chronic health effects. The results of this effort should feed into other prevention options research in the overall project.

In addition, this effort will evaluate ongoing prevention research to identify both demonstration opportunities and technical/institutional barriers which can be impacted by this and other research programs. The information which is obtained will be assembled into a document suitable for transfer to the public, to industry, or to governmental researchers or regulators.

b. Demonstration Project

The Prevention Options Availability report will identify potentially viable consumer product substitutes and technical/institutional barriers to prevention of VOC and air toxic emissions. In order to inject potential substitutes into the marketplace, projects to demonstrate the effectiveness of technologies and/or overcome institutional barriers are necessary. This task provides for one or more of these demonstrations. A final report will be prepared for each demonstration.

c. Aerosol Propellant/Packaging Changes

AEERL has just completed the initial work in this research area and will publish a report characterizing the nature of this source sector and potential prevention options. Approximately 3 billion units are utilized in the U.S.

each year. Such units release approximately 590,000 Mg (1.3 billion lb) of various organics to the atmosphere. Research to be undertaken during fiscal year 1991 will enable EPA to pursue implementation of aerosol product emissions prevention options. Research activities may include:

- Defining alternatives to organics for propellants and carrier solvents in aerosol packaging, such as compressed inorganic gases;
- Investigating several new, and improving existing, packaging alternatives to aerosols;
- Calculating VOC and air toxic emission reductions which may result from the use of alternative propellants or consumer product packaging options;
- Evaluating innovative and existing aerosol packaging; emphasis will also be on the possibility of refilling containers, thereby reducing VOC emissions as well as waste disposal problems; and
- Incorporating results into a technical options report.

2. DEVELOPMENT OF THE TECHNICAL BASIS FOR A PESTICIDE INERTS STRATEGY

Carriers and solvents in pesticide formulations are potentially the source of substantial environmental problems on both domestic and global scales. OPP has addressed toxicity issues in its pesticide inerts strategy. However, these solvents, many of which are VOCs, stratospheric ozone depleters, or greenhouse gases, continue to be released to the atmosphere during use of the pesticide. For example, the large amount of VOCs released puts pesticides high on the list of sources which are being addressed by states and urban areas attempting to achieve the ozone standard. The

pesticides inerts strategy does not presently have a technical basis for dealing with this cross-regulatory problem. The proposed research will establish an extension of the inerts strategy by developing a technically based decision making approach which can be used by OPP in influencing choices of inerts utilized in pesticide formulations. Specific research activities will include:

- Enhancing other VOC reduction projects by identifying the amounts and types of inerts used in pesticides; and
- Extending the current four category inerts approach by developing a second tier of categories which will not only take into account primarily photochemical reactivity but also consider stratospheric ozone depletion and greenhouse potential factors.

PERFORMANCE MEASURES

The effective performance of this project will be assessed by monitoring progress in four areas.

1. COMPLETION OF RESEARCH PRODUCTS

The timely completion of quality research products is the first, and most easily assessed, step toward reducing emissions from area sources.

2. TECHNOLOGY TRANSFER

Completion of the proposed research will provide an impressive array of pollution prevention information for coatings and consumer products. The success of this project must be judged on how efficiently this information reaches its audience. Industry needs to provide environmentally safe products

and use acceptable processing techniques. The consumer needs to know that low-polluting alternatives are available and use them. Federal, State, and local air pollution control agencies need to drive the process through innovative regulation and effective ombudsmanship of emerging low-polluting technologies.

3. APPLICATION OF RESULTS

The successful application of the results of this research program is, in many ways, a more meaningful benchmark than the success of technology transfer efforts as evaluated by the number of reports and presentations that are provided to the public. Results can be catalogued in such areas as: 1) Use in policy and regulatory development; 2) Documentation of continued applications research in industry; 3) Use of demonstrated prevention options in commerce; and 4) Acceptance of prevention options as established methods for reducing VOC, air toxic, and other pollutant emissions.

4. EVALUATION OF IMPACT ON VOLATILE ORGANIC EMISSIONS

As an overall measure of success, projections of the total environmental gains expected from all program components will be made at the end of each year. Each research effort will need to determine the magnitude of its success by establishing a baseline against which to quantify emissions reductions.

SUMMARY

Under the leadership of EPA's Air and Energy Engineering Research Laboratory, a research program, entitled "Demonstration of Emerging Area Source Prevention Options for Volatile Organics," is underway. The program's overall goal is to reduce VOC emissions from stationary area sources by

developing, evaluating, and/or demonstrating pollution prevention options.

The program includes two major project areas. The Alternative Coating Materials and Processes task seeks to meet this goal initially through the preparation of two background documents: Evaluation of Potential Coating Technologies, and Proceedings: Surface-Coating-Free Materials Workshop. These will bring together information about opportunities for prevention and provide a basis for future demonstration projects. Several coatings demonstration projects will then be selected and completed. The second program area, Consumer Product Prevention Options, addresses consumer products and pesticide inerts. In doing so, it will support several efforts to reduce VOCs, air toxics, and other environmentally adverse emissions from these products.

Given the continued close cooperation of the work group members -- EPA's Air and Energy Engineering Research Laboratory, EPA's Region 9, EPA's Office of Pesticides and Toxic Substances, EPA's Office of Air Quality Planning and Standards, the South Coast Air Quality Management District, the Northeast States for Coordinated Air Use Management, the New York State Department of Environmental Conservation, and the California Air Resources Board -- and the successful solicitation of industry participation, substantial benefits to the environment are anticipated from this project.